EDGES MEMO #139

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
HAYSTACK OBSERVATORY
WESTFORD, MASSACHUSETTS 01886

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Telephone: 781-981-5400
Fax: 781-981-0590

To: EDGES Group

From: Alan E.E. Rogers

Subject: Additive and multiplicative terms in foreground, ionosphere and antenna loss.

Multiplicative terms are the scale spectral index and "gamma" of the foreground from

$$T_{sky} = af^{s+\gamma \log f}$$

So that $\log\left(T_{sky}\right) = a + s\log f + \gamma\left(\log f\right)^2$

Where T_{sky} = sky temperature

s = spectral index

γ = "gamma"

f = normalized frequency

a = sky temperature for $f = 1$

Other multiplicative terms are the ionospheric absorption and antenna beam correction factor since these terms act on the foreground sky temperature. Additive terms are the resistive loss, antenna ground loss and ionospheric emission since those depends on the ambient and electron temperature. In the case of the emission from the ionosphere the antenna temperature, T_A is

$$T_A = T_{sky} + \tau_0 T_e f^{-2.0}$$

where τ_0 is the ionosphere opacity and T_e is the electron temperature.

Since the effects of both the multiplicative and additive are small there is little difference in fitting the antenna temperature directly or fitting the log of the antenna temperature. It is point out however that the basis function number 4 is memo 118 is for the departure of the spectral index from -2.5 and another basis function

$$\left(\log f\right)^2 f^{-2.5}$$

Is needed for "gamma". Early tests with the calibrated data from EDGES-2 indicate that the separate basis functions for point sources and free-free emission may not be needed when the "gamma" term is included. For example, a fit using only 3 basis functions shown in Fig. 1. has rms residual of 310 mK in recent data from EDGES-2 when the Galaxy is mostly below the horizon.

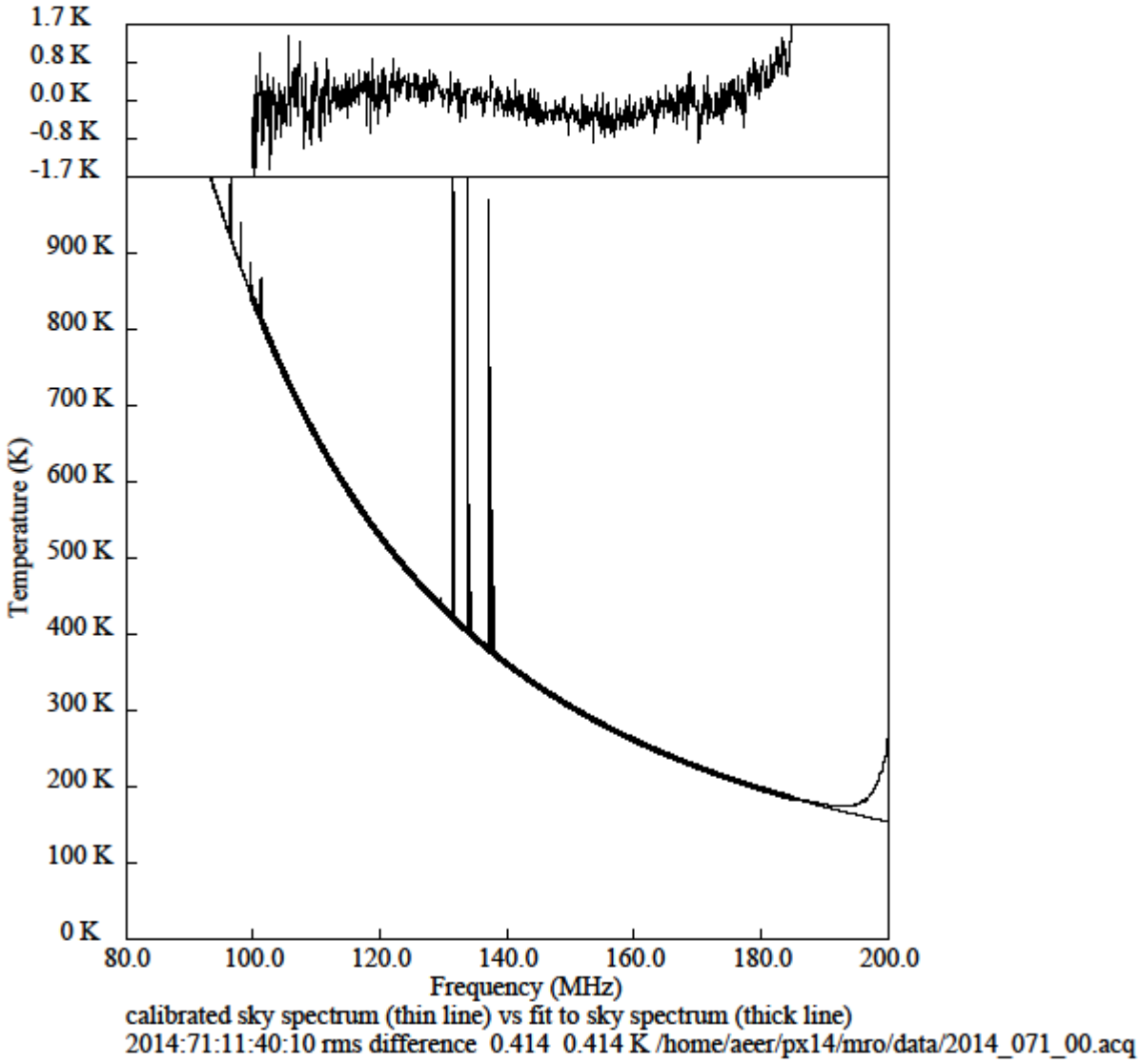

Figure 1. 3 term fit to data for 11 hours before transit of Galactic center.